

CoolMOS™ Power Transistor
Features

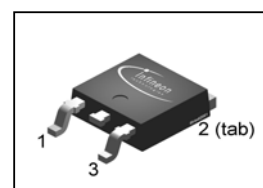
- Lowest figure-of-merit $R_{ON} \times Q_g$
- Extreme dv/dt rated
- High peak current capability
- Fully qualified according to JEDEC for Industrial Applications
- Pb-free lead plating; RoHS compliant, available in Halogen free mold compound^{a)}
- Ultra low gate charge

Product Summary

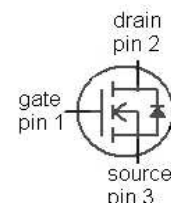
$V_{DS} @ T_J=25^\circ\text{C}$	900	V
$R_{DS(on),max} @ T_J=25^\circ\text{C}$	1.2	Ω
$Q_{g,typ}$	28	nC

CoolMOS™ 900V is designed for:

- Quasi Resonant Flyback / Forward topologies
- PC Silverbox and consumer applications
- Industrial SMPS


PG-TO252


Type	Package	Marking
IPD90R1K2C3	PG-TO252	9R1K2C


Maximum ratings, at $T_J=25^\circ\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous drain current	I_D	$T_C=25^\circ\text{C}$	5.1	A
		$T_C=100^\circ\text{C}$	3.2	
Pulsed drain current ²⁾	$I_{D,pulse}$	$T_C=25^\circ\text{C}$	10	
Avalanche energy, single pulse	E_{AS}	$I_D=0.92\text{ A}, V_{DD}=50\text{ V}$	68	mJ
Avalanche energy, repetitive t_{AR} ^{2),3)}	E_{AR}	$I_D=0.92\text{ A}, V_{DD}=50\text{ V}$	0.31	
Avalanche current, repetitive t_{AR} ^{2),3)}	I_{AR}		0.92	A
MOSFET dv/dt ruggedness	dv/dt	$V_{DS}=0\dots 400\text{ V}$	50	V/ns
Gate source voltage	V_{GS}	static	± 20	V
		AC ($f>1\text{ Hz}$)	± 30	
Power dissipation	P_{tot}	$T_C=25^\circ\text{C}$	83	W
Operating and storage temperature	T_J, T_{stg}		-55 ... 150	$^\circ\text{C}$

^{a)} non-Halogen free (OPN: IPD90R1K2C3BT); Halogen free (OPN: IPD90R1K2C3AT)

Maximum ratings, at $T_J=25\text{ }^{\circ}\text{C}$, unless otherwise specified

Parameter	Symbol	Conditions	Value	Unit
Continuous diode forward current	I_S	$T_C=25\text{ }^{\circ}\text{C}$	2.8	A
Diode pulse current ²⁾	$I_{S,pulse}$		11	
Reverse diode dv/dt ⁴⁾	dv/dt		4	V/ns

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Thermal characteristics

Thermal resistance, junction - case	R_{thJC}		-	-	1.5	K/W
Thermal resistance, junction - ambient	R_{thJA}	leaded	-	-	62	
Soldering temperature, wavesoldering only allowed at leads	T_{solder}	1.6 mm (0.063 in.) from case for 10 s	-	-	260	$^{\circ}\text{C}$

Electrical characteristics, at $T_J=25\text{ }^{\circ}\text{C}$, unless otherwise specified

Static characteristics

Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0\text{ V}$, $I_D=250\text{ }\mu\text{A}$	900	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_D=0.31\text{ mA}$	2.5	3	3.5	
Zero gate voltage drain current	I_{DSS}	$V_{DS}=900\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=25\text{ }^{\circ}\text{C}$	-	-	1	μA
		$V_{DS}=900\text{ V}$, $V_{GS}=0\text{ V}$, $T_J=150\text{ }^{\circ}\text{C}$	-	10	-	
Gate-source leakage current	I_{GSS}	$V_{GS}=20\text{ V}$, $V_{DS}=0\text{ V}$	-	-	100	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10\text{ V}$, $I_D=2.8\text{ A}$, $T_J=25\text{ }^{\circ}\text{C}$	-	0.94	1.2	Ω
		$V_{GS}=10\text{ V}$, $I_D=2.8\text{ A}$, $T_J=150\text{ }^{\circ}\text{C}$	-	2.5	-	
Gate resistance	R_G	$f=1\text{ MHz}$, open drain	-	1.3	-	Ω

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	

Dynamic characteristics

Input capacitance	C_{iss}	$V_{GS}=0\text{ V}, V_{DS}=100\text{ V},$ $f=1\text{ MHz}$	-	710	-	pF
Output capacitance	C_{oss}		-	35	-	
Effective output capacitance, energy related ⁵⁾	$C_{o(er)}$	$V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$ to 500 V	-	23	-	
Effective output capacitance, time related ⁶⁾	$C_{o(tr)}$		-	86	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD}=400\text{ V},$ $V_{GS}=10\text{ V}, I_D=2.8\text{ A},$ $R_G=81.3\ \Omega$	-	70	-	ns
Rise time	t_r		-	20	-	
Turn-off delay time	$t_{d(off)}$		-	400	-	
Fall time	t_f		-	40	-	

Gate Charge Characteristics

Gate to source charge	Q_{gs}	$V_{DD}=400\text{ V}, I_D=2.8\text{ A},$ $V_{GS}=0\text{ to }10\text{ V}$	-	3.2	-	nC
Gate to drain charge	Q_{gd}		-	12	-	
Gate charge total	Q_g		-	28	tbd	
Gate plateau voltage	$V_{plateau}$		-	4.6	-	V

Reverse Diode

Diode forward voltage	V_{SD}	$V_{GS}=0\text{ V}, I_F=2.8\text{ A},$ $T_j=25\text{ °C}$	-	0.8	1.2	V
Reverse recovery time	t_{rr}	$V_R=400\text{ V}, I_F=I_S,$ $di_F/dt=100\text{ A}/\mu\text{s}$	-	310	-	ns
Reverse recovery charge	Q_{rr}		-	3.7	-	μC
Peak reverse recovery current	I_{rrm}		-	19	-	A

²⁾ Pulse width t_p limited by $T_{J,max}$

³⁾ Repetitive avalanche causes additional power losses that can be calculated as $P_{AV}=E_{AR} \cdot f$.

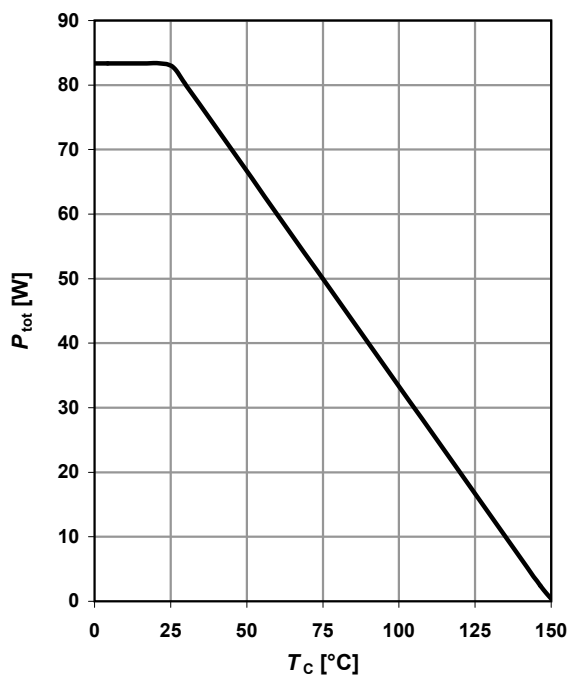
⁴⁾ $I_{SD} \leq I_D$, $di/dt \leq 200\text{ A}/\mu\text{s}$, $V_{DClk}=400\text{ V}$, $V_{peak} < V_{(BR)DSS}$, $T_J < T_{J,max}$, identical low side and high side switch

⁵⁾ $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as C_{oss} while V_{DS} is rising from 0 to 50% V_{DSS} .

⁶⁾ $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as C_{oss} while V_{DS} is rising from 0 to 50% V_{DSS} .

1 Power dissipation

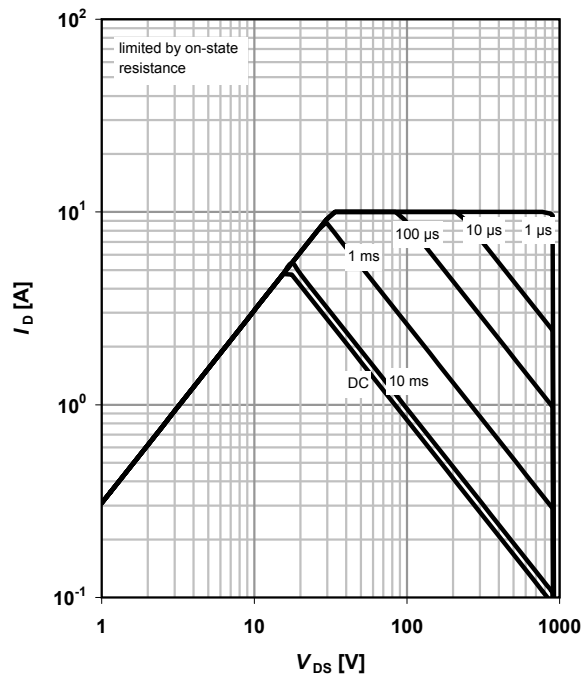
$$P_{\text{tot}} = f(T_C)$$



2 Safe operating area

$$I_D = f(V_{DS}); T_C = 25^\circ\text{C}; D = 0$$

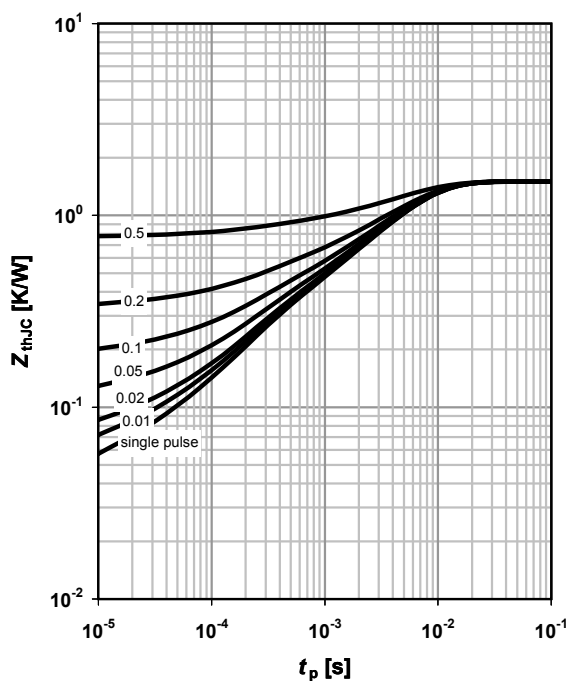
parameter: t_p



3 Max. transient thermal impedance

$$Z_{\text{thJC}} = f(t_p)$$

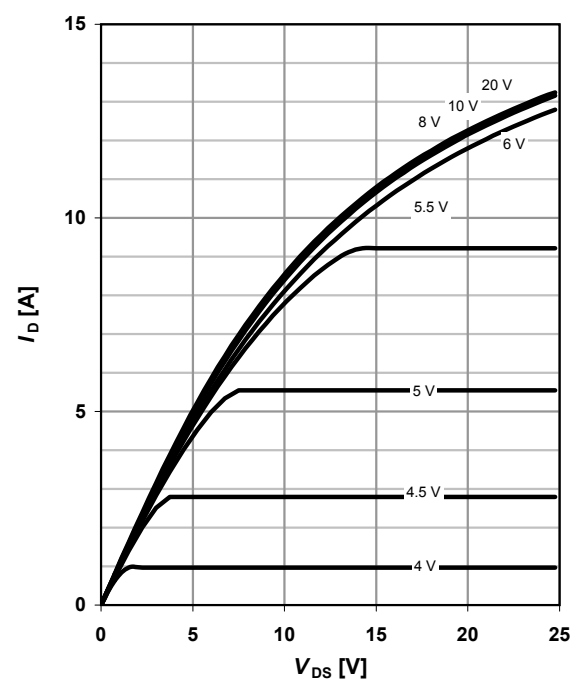
parameter: $D = t_p / T$



4 Typ. output characteristics

$$I_D = f(V_{DS}); T_J = 25^\circ\text{C}$$

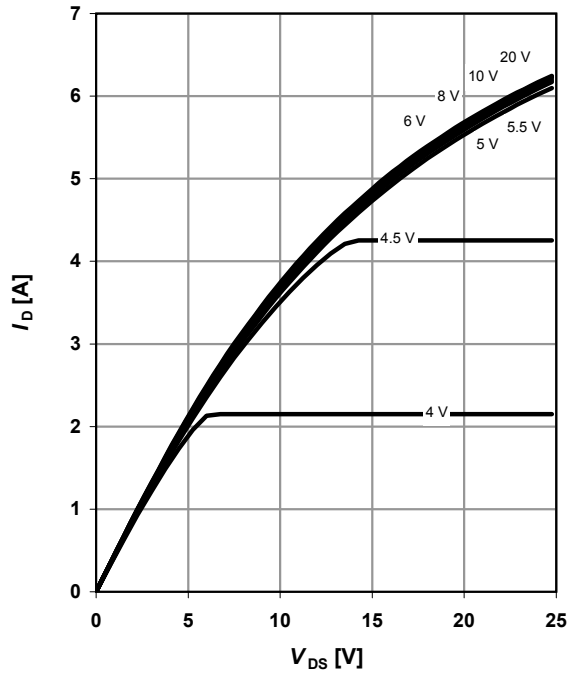
parameter: V_{GS}



5 Typ. output characteristics

$$I_D = f(V_{DS}); T_J = 150^\circ\text{C}$$

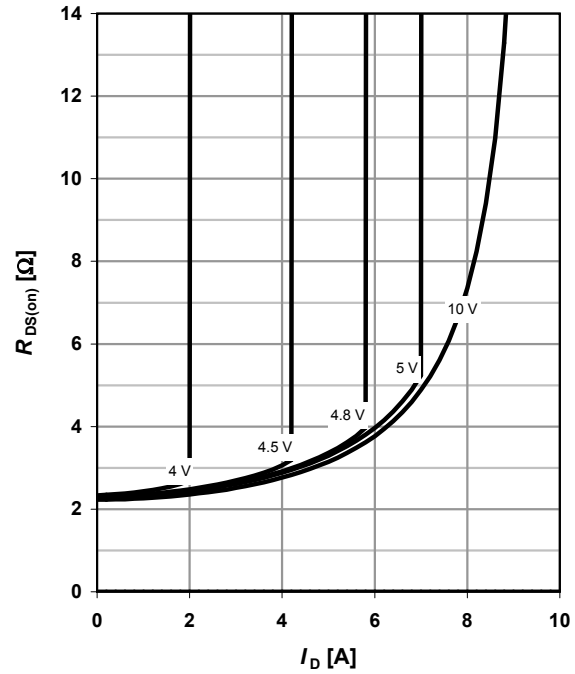
parameter: V_{GS}



6 Typ. drain-source on-state resistance

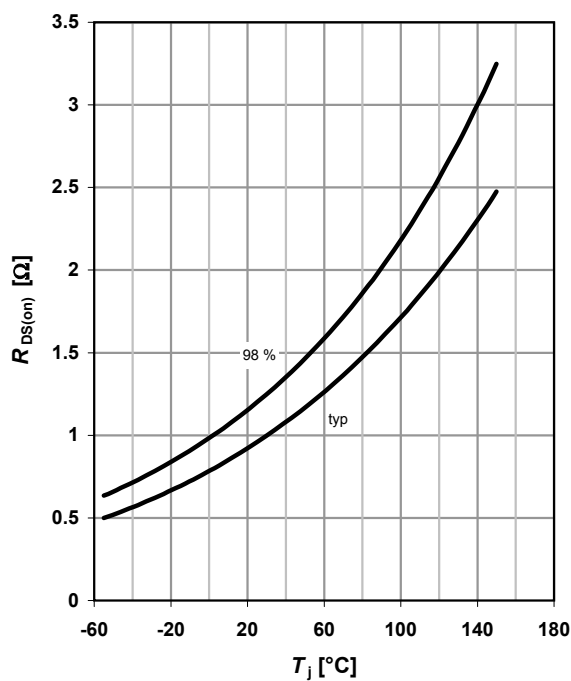
$$R_{DS(on)} = f(I_D); T_J = 150^\circ\text{C}$$

parameter: V_{GS}



7 Drain-source on-state resistance

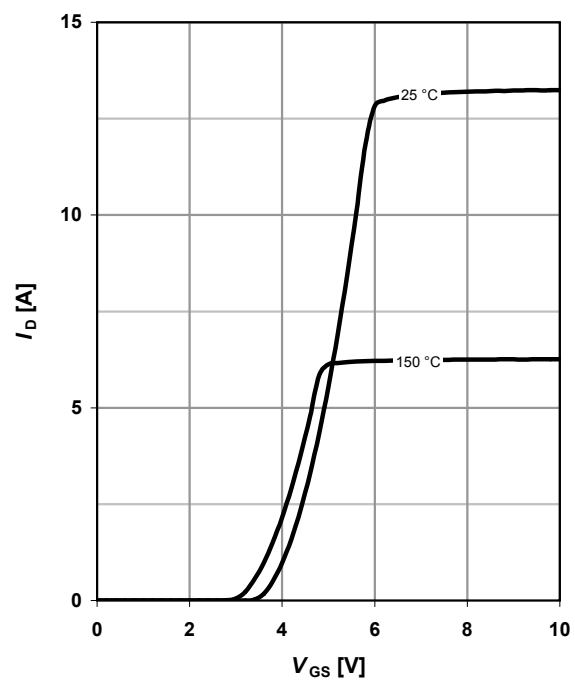
$$R_{DS(on)} = f(T_J); I_D = 2.8\text{ A}; V_{GS} = 10\text{ V}$$



8 Typ. transfer characteristics

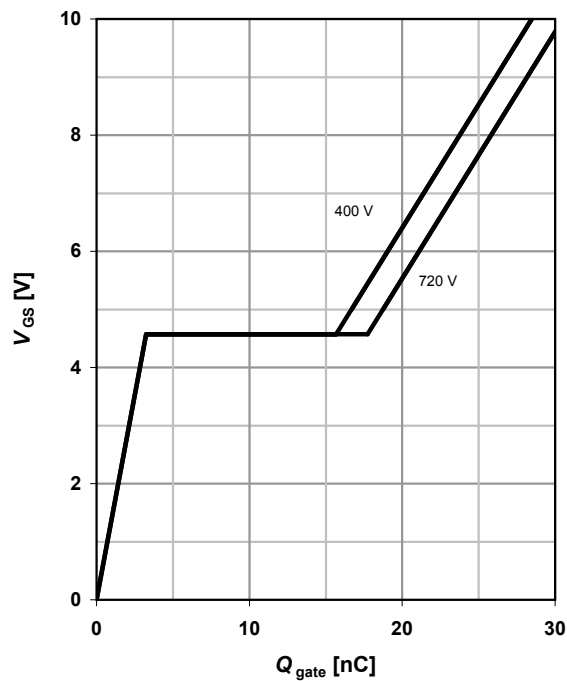
$$I_D = f(V_{GS}); V_{DS} = 20\text{ V}$$

parameter: T_J



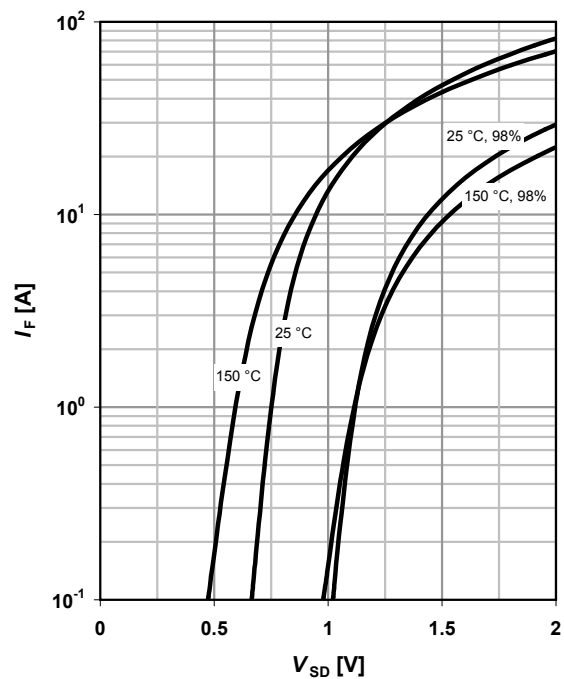
9 Typ. gate charge

 $V_{GS}=f(Q_{gate}); I_D=2.8 \text{ A pulsed}$

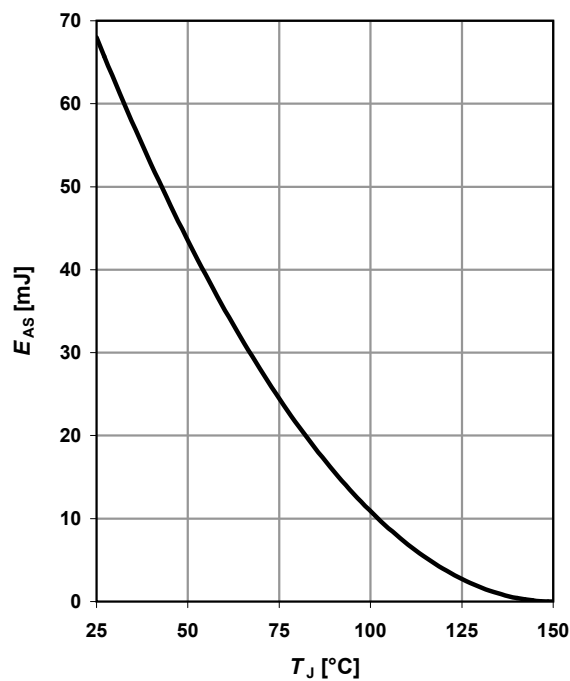
parameter: V_{DD}


10 Forward characteristics of reverse diode

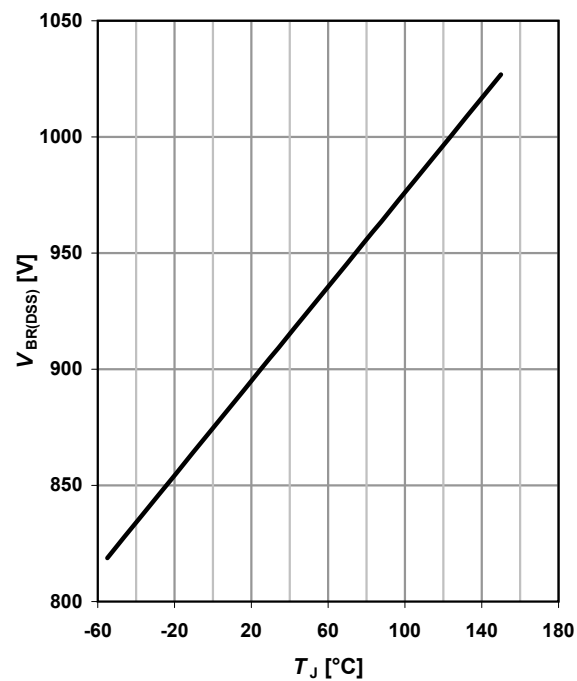
 $I_F=f(V_{SD})$

parameter: T_J


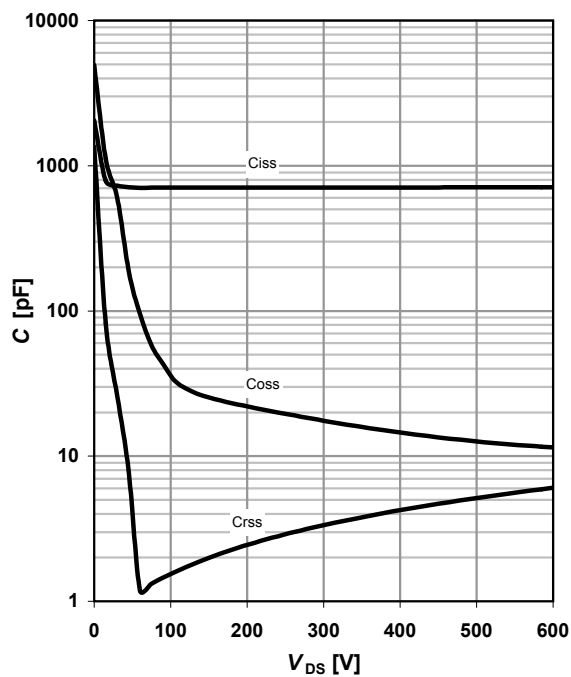
11 Avalanche energy

 $E_{AS}=f(T_J); I_D=0.92 \text{ A}; V_{DD}=50 \text{ V}$


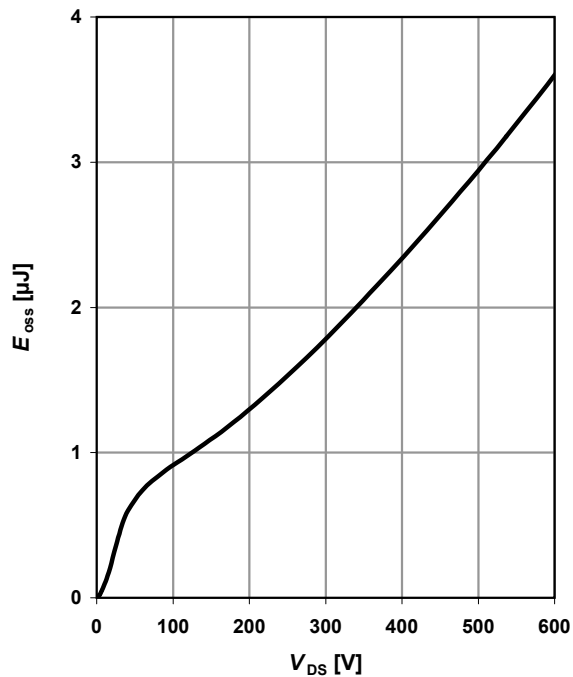
12 Drain-source breakdown voltage

 $V_{BR(DSS)}=f(T_J); I_D=0.25 \text{ mA}$


13 Typ. capacitances

 $C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$


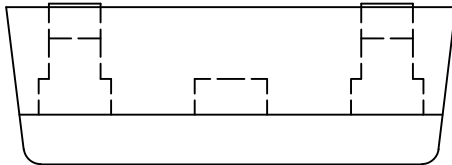
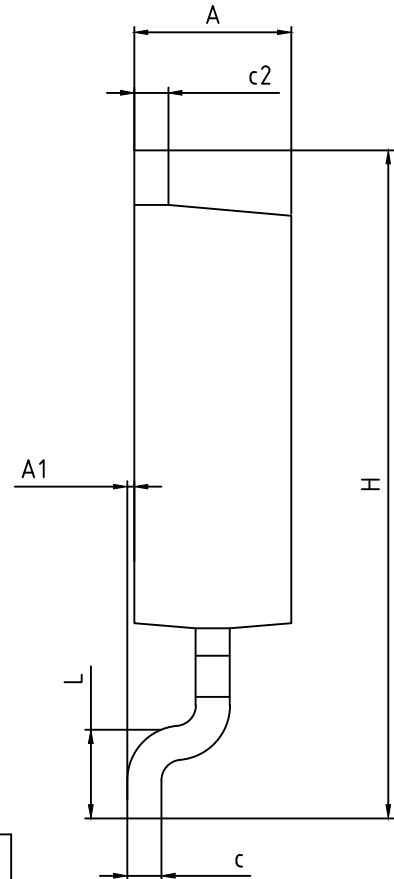
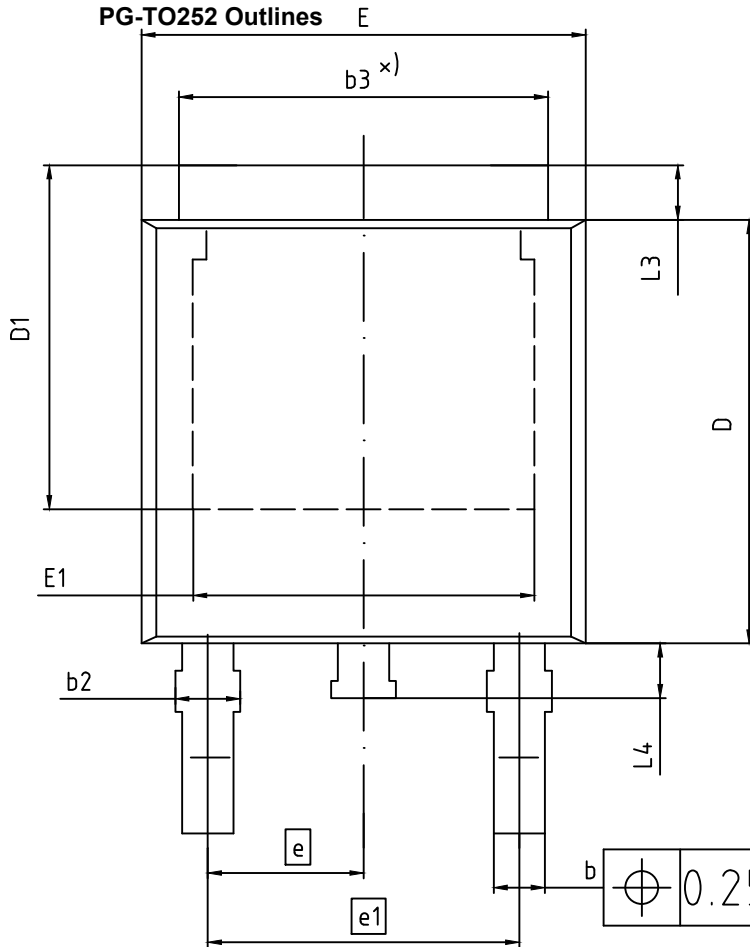
14 Typ. C_{oss} stored energy

 $E_{oss} = f(V_{DS})$


Definition of diode switching characteristics

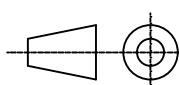


PG-T0252 Outlines



ALL DIMENSIONS REFER TO JEDEC
STANDARD TO-252 AND DO NOT INCLUDE MOLD
FLASH OR PROTRUSIONS.

DIMENSION	MILLIMETERS	
	MIN.	MAX.
A	2.16	2.41
A1	0.00	0.15
b	0.64	0.89
b2	0.65	1.15
b3	4.95	5.50
c	0.46	0.61
c2	0.40	0.98
D	5.97	6.22
D1	5.02	5.84
E	6.35	6.73
E1	4.32	5.50
e	2.29	
e1	4.57	
N	3	
H	9.40	10.48
L	1.18	1.78
L3	0.89	1.27
L4	0.51	1.02

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Revision: 2020-05-26, Rev. 2.1

Previous Revision

Revision	Date	Subjects (major changes since last revision)
2.1	2020-05-26	Update package outline

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